WHAT IS CLAIMED IS:

1. A method of controlling steam flow through a steam turbine having a turbine rotor, the method comprising:

(a) determining a maximum heat transfer rate based on thermal stress calculations in the turbine rotor;

(b) calculating a maximum steam flow rate based on the maximum heat transfer rate;

(c) determining an actual steam flow rate through the steam turbine; and

(d) controlling a turbine inlet valve based on a difference between the actual steam flow rate and the maximum steam flow rate.

2. A method according to claim 1, wherein step (a) is practiced by determining a rotor surface stress and a rotor bore stress based on (1) a difference between rotor surface temperature and rotor bore temperature and (2) average rotor temperature.

3. A method according to claim 2, wherein step (b) is practiced by calculating the maximum steam flow rate (W_{max}) based on the maximum heat transfer rate (Q_{max}), steam temperature (T_{stm}) and turbine metal temperature (T_{MTL}).

4. A method according to claim 3, wherein step (b) is practiced by calculating the maximum steam flow rate (W_{max}) according to the following relation:

$$W_{max} = W_{1r} \times \left(\frac{Q_{max}}{abs(T_{stm} - T_{mtl}) \times k1} \right)^{k2}$$

where W_{1r} is a rated inlet flow (lbm/sec), and k1 and k2 are tuning constants.

5. A method according to claim 1, wherein step (b) is practiced by calculating the maximum steam flow rate (W_{max}) based on the maximum heat transfer rate (Q_{max}), steam temperature (T_{stm}) and turbine metal temperature (T_{MTL}).

6. A method according to claim 5, wherein step (b) is practiced by calculating the maximum steam flow rate (W_{max}) according to the following relation:

$$W_{max} = W_{1r} \times \left(\frac{Q_{max}}{abs(T_{stm} - T_{mtl}) \, x \, k1} \right)^{k2}$$

where W_{1r} is a rated inlet flow (lbm/sec), and k1 and k2 are tuning constants.

7. A method according to claim 1, wherein step (c) is practiced by determining the actual steam flow rate through the steam turbine based on inlet steam pressure (P1), inlet steam temperature (T1), and exit steam pressure (P2).

8. A method according to claim 7, wherein step (c) is practiced by determining the actual steam flow rate through the steam turbine according to the following relations:

$$W_1 = k\sqrt{\rho_1 P_1 (1 - X^2)}$$

with $X = \frac{P_2}{P_1}$, $\rho_1 = f(P_1, T_1)$, $k = \frac{W_{1r}}{\sqrt{\rho_{1r} P_{1r} (1 - X_r^2)}}$, $X_r = \frac{P_{2r}}{P_{1r}}$ and

$\rho_{1r} = f(P_{1r}, T_{1r})$,

where P_{1r} is rated inlet pressure (PSIA), P_{2r} is rated outlet pressure (PSIA), T_{1r} is rated inlet temperature (F), and W_{1r} is rated inlet flow (lbm/sec).

9. A method of operating a steam turbine having a turbine rotor, the method comprising:

(a) calculating a maximum steam flow rate based on parameters relating to thermal stresses in the turbine rotor;

(b) determining an actual steam flow rate through the steam turbine; and

(c) controlling a turbine inlet valve based on a difference between the actual steam flow rate and the maximum steam flow rate.

10. A method according to claim 9, wherein the parameters relating to thermal stresses in step (a) comprise a rotor surface stress and a rotor bore stress determined based on (1) a difference between rotor surface temperature and rotor bore temperature and (2) average rotor temperature.

11. A method according to claim 10, wherein step (a) is practiced by calculating the maximum steam flow rate (W_{max}) based on a maximum heat transfer rate (Q_{max}), steam temperature (T_{stm}) and turbine metal temperature (T_{MTL}).

12. A method according to claim 11, wherein step (a) is practiced by calculating the maximum steam flow rate (W_{max}) according to the following relation:

$$W_{max} = W_{1r} \times \left(\frac{Q_{max}}{abs(T_{stm} - T_{mtl}) \times k1} \right)^{k2}$$

where W_{1r} is a rated inlet flow (lbm/sec), and k1 and k2 are tuning constants.

13. A method according to claim 9, wherein step (a) is practiced by calculating the maximum steam flow rate (W_{max}) based on a maximum heat transfer rate (Q_{max}), steam temperature (T_{stm}) and turbine metal temperature (T_{MTL}).

14. A method according to claim 13, wherein step (a) is practiced by calculating the maximum steam flow rate (W_{max}) according to the following relation:

$$W_{max} = W_{1r} \times \left(\frac{Q_{max}}{abs(T_{stm} - T_{mtl}) \times k1} \right)^{k2}$$

where W_{1r} is a rated inlet flow (lbm/sec), and k1 and k2 are tuning constants.

15. A method according to claim 9, wherein step (b) is practiced by determining the actual steam flow rate through the steam turbine based on inlet steam pressure (P1), inlet steam temperature (T1), and exit steam pressure (P2).

16. A method according to claim 15, wherein step (b) is practiced by determining the actual steam flow

rate through the steam turbine according to the following relations:

$$W_1 = k\sqrt{\rho_1 P_1 (1 - X^2)}$$

with $X = \frac{P_2}{P_1}$, $\rho_1 = f(P_1, T_1)$, $k = \frac{W_{1r}}{\sqrt{\rho_{1r} P_{1r} (1 - X_r^2)}}$, $X_r = \frac{P_{2r}}{P_{1r}}$ and $\rho_{1r} = f(P_{1r}, T_{1r})$,

where P_{1r} is rated inlet pressure (PSIA), P_{2r} is rated outlet pressure (PSIA), T_{1r} is rated inlet temperature (F), and W_{1r} is rated inlet flow (lbm/sec).

17. A control system for controlling steam flow through a steam turbine having a turbine rotor, the control system comprising:

a first temperature measuring device that measures inlet steam temperature;

a second temperature measuring device that measures a rotor surface temperature as approximated by shell inner surface temperature;

a first pressure measuring device that measures inlet steam pressure;

a second pressure measuring device that measures exit steam pressure; and

a controller communicating with said first and second temperature measuring devices and said first and second pressure measuring devices, the controller determining a maximum heat transfer rate according to a rotor surface stress and a rotor bore stress determined based on (1) a difference between rotor surface temperature and an approximated rotor bore temperature

and (2) average rotor temperature thermal stress calculations in the turbine rotor,

wherein the controller calculates a maximum steam flow rate based on the maximum heat transfer rate, wherein the controller determines an actual steam flow rate through the steam turbine based on inlet steam pressure, inlet steam temperature and exit steam pressure, and wherein the controller controls a turbine inlet valve based on a difference between the actual steam flow rate and the maximum steam flow rate.